Providing Best Available Science for Planning for Renewable Energy and Conservation in California's Deserts

CALIFORNIA ENERGY COMMISSION
ENERGY RESEARCH & DEVELOPMENT DIVISION

The California desert region is a remarkable place, home to an impressive array of sensitive species and their habitats, a robust cultural heritage, and recreational opportunities for residents and visitors. Yet there is much more – the California desert supports a variety of communities, military installations, and business interests, including agriculture, mining, and tourism. It also has an abundance of some of the best solar, wind, and geothermal resources in the nation. These renewable resources will play a critical role in reducing greenhouse gasses to address climate change and promote energy independence during the next decades.

The State of California and the federal government initiated the *Desert Renewable Energy Conservation Plan* (DRECP) in 2009, identifying preferable areas covering more than 22 million acres in the California desert to develop renewable energy and conserve biological resources. The DRECP is an innovative, landscape-scale planning effort using a robust collection of the best available scientific information to develop a conservation plan that, once implemented, will be continuously monitored through 2040. The DRECP is focused on the desert regions and adjacent lands of seven California counties – Imperial, Inyo, Kern, Los Angeles, Riverside, San Bernardino, and San Diego. At the time the DRECP was initiated, state and federal agencies determined more data was required where animals and plants exist, how vulnerable they are to climate change and development, and what can be done to minimize impacts from energy development.

The California Energy Commission developed and funded a suite of research projects to support the design and implementation of the DRECP. Some studies compiled or modeled basic data on where species exist, their habitat needs, and how and where they use the landscape. Other studies investigated how renewable energy development might impact species or designed new analytical tools to predict impacts. To increase the effectiveness of prescribed mitigation, innovative strategies were tested, and analytical tools were developed to evaluate alternative mitigation actions. Finally, new data have been collected to better monitor the actual impacts of projects during construction and operation, and use lessons learned about the response of species to energy development. Many of these tools and methods are also available to strengthen renewable energy development and planning strategies in other California regions.

Overall, the Energy Research and Development Division of the Energy Commission funded 13 research projects, and the Siting, Transmission and Environmental Protection Division funded a project to map vegetation. These projects, totaling almost $6.9 million were leveraged with about $486,000 in matching funds from other private and public sources. Collectively, these projects address high-priority gaps of different planning phases, focusing on the most critical species. These gaps were identified with California Department of Fish and Wildlife, the Energy Commission's Siting, Transmission and Environmental Protection Division, independent science advisors, and others. Each project has been used in developing the DRECP or is expected to be used during plan implementation and is summarized in this booklet. This research illuminates the importance of a state-level, public-interest energy research program.

The Role of Research and Mapping Projects in the Development or Implementation Phases of the DRECP

Some projects are repeated if they are being applied in the development and implementation phases of the DRECP.

PROJECT	DEVELOPMENT PHASE
Vegetation Mapping as the Cornerstone for Renewable Energy and Conservation Planning	» Map and classify natural communities consistently throughout the DRECP plan area to accurately assess potential impacts and conservation needs » Inputs to DRECP species modeling efforts » Identify rare natural communities and rare plant population locations for avoidance and conservation » Assist in assessing and validating species-specific habitat connectivity and general landscape connectivity » Help identify intact landscape areas required to maintain ecological processes within the DRECP Planning Area » Evaluate future climate change-driven effects on species habitat » Identify and prioritize natural communities and locally rare communities for conservation » assess impacts and habitat conservation
Mohave Ground Squirrel (MGS) Habitat Modeling to Guide Solar Development	» Identify and map important areas for MGS (population centers, population expansion areas, landscape linkages, and climate change areas) » Assess impacts and habitat conservation
Assessing Desert Tortoise Survival and Reproduction at a Wind Energy Facility Near Palm Springs	» Inform DRECP about desert tortoise ecological responses to stressors
Spatial Decision Support Tool for Desert Tortoises at Solar Installations	» Evaluate potential development focus area (DFA) impacts » Determine and recommend most effective and appropriate types of nonacquisition (management) compensation measures for desert tortoise on an ecoregional basis
Cumulative Biological Impacts Framework	» Model the distributions of 65 covered and other species » Collaboratively, with modelers and biologists at Conservation Biology Institute, USGS, UC Davis, and the DRECP agencies, resolve complex questions about the models and reach a consensus to resolving inconsistencies in data and modeling to achieve the best available science and modeling
Mapping Habitat Distributions of Desert Rare Plants	» Inform species modeling » Identify locations of rare plant populations » Assess impacts and habitat conservation

PROJECT	IMPLEMENTATION PHASE
Assessing Desert Tortoise Survival and Reproduction at a Wind Energy Facility Near Palm Springs	» Inform facility siting decisions, species monitoring techniques for the Monitoring and Adaptive Management Plan, and management measures for the desert tortoise
Spatial Decision Support Tool for Desert Tortoises at Solar Installations	» Help select and evaluate alternative management actions and the effectiveness of management actions for desert tortoise conservation » Assist with facility siting decisions within DFAs at the project level
Improving Decision Support Relative to Solar Energy Projects and the Desert Tortoise	» Help select and evaluate alternative management actions and the effectiveness of management actions for desert tortoise conservation » Assist with facility siting decisions within DFAs at the project level
Improving Mitigation Success for Desert Tortoises at Renewable Energy Development Projects	» Provide data for and assist with refinement of habitat models » Refine and validate head-start techniques as a population augmentation technique to help conserve the desert tortoise in the DRECP plan area
Effect of Solar Development and Operation on Desert Kit Foxes	» Inform DRECP on desert kit fox Impacts » Assist with siting facilities and assessing impacts within DFAs » Developing protective measures for the desert kit fox
Mapping Habitat Distributions of Desert Rare Plants	» Inform developers and agencies siting facilities in DFAs at the project level for desert rare plants
Population Viability and Restoration Potential for Rare Plants Near Solar Installations	» Help assess and manage the long-term conservation of rare plants in the DRECP area » Help identify appropriate habitat restoration techniques as a management tool
Cumulative Biological Impacts Framework	» Inform management of covered species and reserve areas in response to climate change » Help select development areas to avoid or minimize impacts » Help select suitable compensation areas for offsetting project impacts » Aggregate and evaluate cumulative impacts of development and potential development areas on a regional basis
Estimating Golden Eagle Abundance in the DRECP Area	» Provide presence/absence data of eagles, data for population estimates, and the validation and refinement of golden eagle habitat models » Provide data to track, verify, and validate eagle conservation actions
Golden Eagles, Their Prey, and Effects of Renewable Energy	» Provide ecological data to improve golden eagle habitat models » Provide ecological information to help formulate and adaptively manage impacts and conservation
Methodology for Characterizing Desert Streams to Facilitate Permitting Solar Energy Projects	» Tool for developers to evaluate alternate siting locations for facilities at the project level within DFAs » Tool for agencies to evaluate stream protection needs and determine protection measures
Carbon Balance in California Deserts: Impacts of Widespread Solar Power Generation	» Provide additional information on the ability of natural desert landscapes to sequester carbon » Provide data to begin to evaluate the effect of vegetation removal and landscape alterations on carbon sequestration at the project level in the DRECP plan area

Vegetation Mapping as the Cornerstone for Renewable Energy and Conservation Planning

Identifying the location, extent, and quality of rare desert plant communities, especially in areas proposed for energy development, provides immediate planning benefits to developers attempting to avoid them and the groups seeking to protect them. Vegetation is often considered the best surrogate for biodiversity, making vegetation maps one of the principal tools in wildlife and natural lands conservation and management. When the DRECP process began, the lack of a comprehensive and dependable vegetation base map was a key information gap faced when creating a regional-level plan.

The Energy Commission contributed to funding new mapping that was completed for 6 million acres of the Mojave and Colorado Deserts. (See map). The mapping process followed rigorous and science-based vegetation classification protocols developed by the California Department of Fish and Wildlife and California Native Plant Society. The project mapped 137 vegetation map classes, underscoring the often-unrecognized diversity of the desert.

Developing an accurate vegetation map for the California desert helps planners identify high-quality habitat for sensitive wildlife and plants and rare vegetation communities. The DRECP study area became the most comprehensive vegetation mapping effort in California and now represents the largest mapped portion of the state using these rigorous protocols.

The vegetation mapping project's three distinct subareas (orange areas) where land cover types and natural communities were mapped with a high level of precision (see below).

Contractor: Aerial Information Systems

Amount: $1,900,000

Term: April 2011 to March 2013

Status: Final report at http://www.energy.ca.gov/2013publications/DRECP-1000-2013-001/DRECP-1000-2013-001.pdf.

Mohave Ground Squirrel Habitat Modeling to Guide Solar Development

Mohave ground squirrels inhabit a limited range in the northwest Mojave Desert and are protected as a California threatened species because of habitat loss caused by humans. Anticipated renewable energy development in the Mojave Desert threatens to further reduce habitat. Within its range, the Mohave ground squirrel has a patchy distribution, and the animal is difficult to detect in field surveys. There were extensive areas where surveys had not been conducted, leaving uncertainties on its habitat quality, distribution, conservation status, and habitat connectivity that made planning for renewable energy difficult.

This project provided new information on the distribution, potential habitat, and habitat corridors of the Mohave ground squirrel. First, a model was developed to describe current habitat suitability and to evaluate losses from previous human development and proposed energy development. The model predicted suitable habitat covering 19,023 square kilometers (7,345 square miles) prior to European settlement; of this, 10-16 percent has been lost to historical human disturbances since European settlement. An additional 10 percent could be affected by renewable energy development in the near future. Second, modeling with different climate change scenarios projected Mojave ground squirrel habitat to shrink substantially. Third, the researchers examined how habitat shifts due to climate change could impact genetic diversity patterns. This highlighted geographic areas that may serve as important pathways for facilitating gene flow among the three genetic groups and allowing movement in response to climate change. Some populations may dramatically shrink and lose genetic diversity needed for the species to survive. Fourth, critical connectivity areas were determined using habitat models in conjunction with current land-use and renewable energy development scenarios. Data from this project are being used in the DRECP to develop conservation and energy alternatives that are compatible with protection of this species now and in the future.

Mohave ground squirrel
Photo: Freya Reder

Modeled suitable habitat for the Mohave ground squirrel
Source: U.S. Geological Survey, Conservation Biology Institute (databasin.org)

Contractor: U.S. Geological Survey

Amount: $223,755

Term: January 2011 to January 2013

Status: Final report at http://www.energy.ca.gov/2014publications/CEC-500-2014-003/CEC-500-2014-003.pdf

Assessing Desert Tortoise Survival and Reproduction at a Wind Energy Facility Near Palm Springs

Much has been published on the effects of wind energy development and operation on flying wildlife species. Very little information is available regarding wind energy facility impacts on nonflying wildlife, such as the Agassiz's desert tortoise (*Gopherus agassizii*).

Sites in the Mojave and Sonoran Deserts have preexisting wind energy facilities dating back more than 25 years. One desert tortoise population on an existing wind farm near Palm Springs, located on public land administered by the U.S. Bureau of Land Management, has been studied at various times since 1992, providing a rare opportunity to assess the long-term effects of wind energy production on this state and federally threatened species. Detailed studies on the demography and reproductive ecology of the desert tortoise began in 1997 and continued through 2009. California Energy Commission funding provided additional data collection in 2010-2011, facilitating a long-term perspective on how this long-lived, threatened species responded to the presence and operation of a wind energy facility. By resurveying the tortoise population marked between 1997-2001, the project had four objectives: 1) generating tortoise population size estimates, 2) determining the survivorship rate of tortoises based on long-term data and the causes of any deaths, 3) determining if tortoises are still reproducing at the same rate observed from 1997-2000, and 4) identifying scientifically defensible methods to reduce the possible negative impacts of wind energy development on tortoises. The study found comparatively high survivorship and reproductive output, the latter most likely because the site was located where rainfall was more reliable than interior desert locations. Sites with less reliable rainfall may experience greater impacts from wind energy. Researchers observed few other differences relative to the ecology of tortoises living in more natural areas. Reducing the negative effects of wind energy development on tortoises may require proper site selection and design, slowing vehicle speeds on site, proper culvert design, maintenance staff awareness, fire prevention and suppression, and continued research and monitoring.

Desert tortoise near wind turbines in the study area near Palm Springs, California. Photo: Jeff Lovich

Contractor: U.S. Geological Survey

Amount: $319,936

Term: March 2010 to June 2013

Cofunding: $127,795

Status: Final report at http://www.energy.ca.gov/2014publications/CEC-500-2014-005/CEC-500-2014-005.pdf

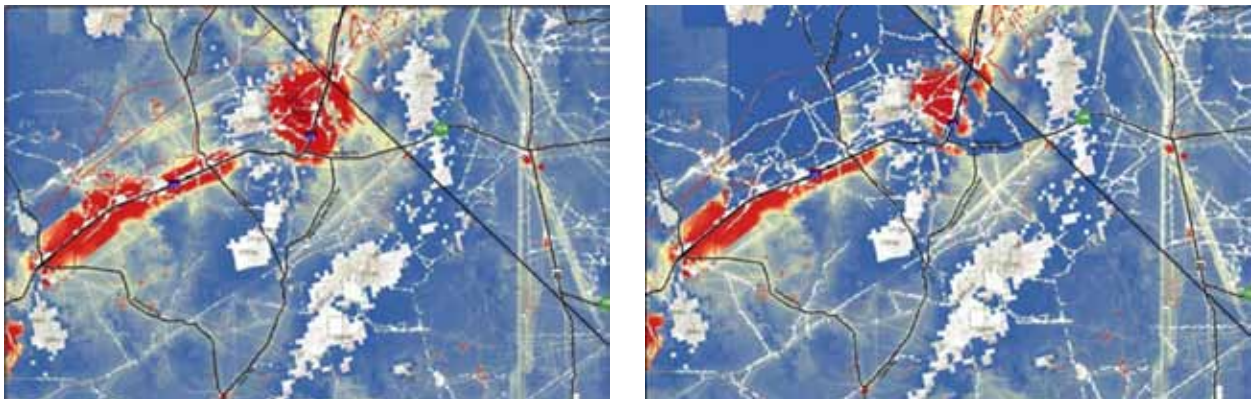
Decision-Support Tool for Desert Tortoises at Solar Installations

Permits often require developers to address impacts to threatened species by restoring habitat, relocating species to unoccupied habitat away from development, or similar activities. The desert tortoise, perhaps the most iconic species for the desert, is listed as threatened on both the California and federal Endangered Species lists. Protecting existing populations and habitat for the desert tortoise, while implementing recovery actions to improve habitat quality, is a high priority as the State evaluates the potential development of solar resources in the desert. Tools are necessary to quantify the cumulative impacts of various developments and to determine the required set of recovery actions and mitigation measures to fully compensate for those impacts.

The University of Redlands and the U.S. Fish and Wildlife Service's Desert Tortoise Recovery Office previously developed a Geographic Information Systems-based decision-support system. The system modeled the interrelationships among existing threats and the impacts to the tortoise population change, and evaluated how those relationships are affected by proposed recovery actions. However, the original version did not explicitly incorporate potential changes in threats, such as from new solar energy development.

This project expanded the original system to support environmental review of new solar energy development projects. The project also developed a Web-based portal, where users can input solar energy development project footprints and run new impact and mitigation calculations.

Agencies are using the system to assess the probable impacts of individual solar energy development projects on the desert tortoise and potential mitigation actions. This system supports agencies in making better, science-based decisions to promote conservation, while reducing uncertainty in the permitting process for the benefit of California's ratepayers.



The map on the left shows the increase in risk to the local tortoise population with the addition of a solar development. The map on the right shows the decreased risk to the tortoise population after implementing recovery actions, such as adding tortoise fencing, instituting a raven management plan, and habitat compensation and restoration. Areas in red show higher risk to the tortoise population; areas in blue show lower risk.

Contractor: Redlands Institute, University of Redlands

Amount: $350,000

Term: February 2011 to July 2013

Cofunding: $69,909

Status: Final report at http://www.energy.ca.gov/2014publications/CEC-500-2014-011/index.html

Cumulative Biological Impacts Framework

California has a goal to provide at least 33 percent of its electricity demand with renewable energy by 2020. Large solar developments are crucial to achieving this goal, but they are land-intensive, and they can have negative impacts on ecosystems and vulnerable species, especially in the desert. This project developed an urgently needed, scientifically defensible framework for assessing biological impacts consistently and reliably, both to protect the state's desert ecosystems and to implement solar energy projects in a timely manner.

Finding Lower-Risk Locations

The first principle for siting renewable energy developments recommended by the DRECP's Independent Science Advisory panel is to maximize the use of disturbed lands to avoid new impacts. This project provided DRECP planners with a spatial model that identifies highly degraded sites near electricity infrastructure that would have the least potential value for biodiversity conservation. (See map.) Energy developers can prospect for areas with lower risks associated with permitting, mitigation costs, and project delay. The model identified 700,000 acres as being most compatible with solar development – ten times more than required in the DRECP to achieve greenhouse gas reduction goals.

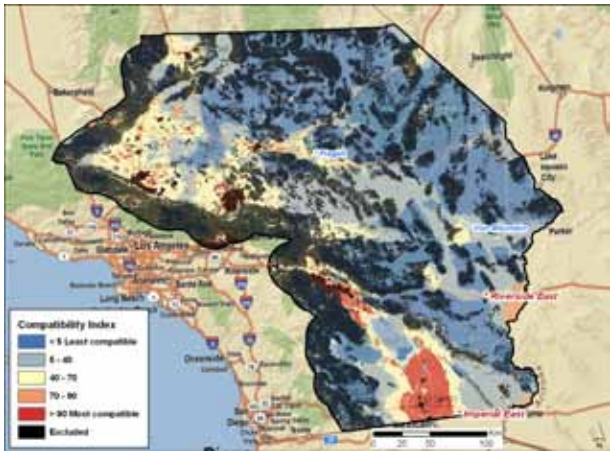
Mitigating Impacts Off-Site

Even with good planning, some impacts may be unavoidable. One option is to offset impacts to sensitive species by protecting and/or restoring other land parcels. Lack of planning tools has hampered identification of cost-effective parcels of land. The project adapted an existing model that will help permitting agencies or developers identify potential sites as mitigation for any project or group of projects in the DRECP area.

Assessing Cumulative Impacts

Software was produced to assess energy development in terms of the onsite and offsite impacts on species habitat extent, location, and condition. This framework offers an explicit, repeatable approach for evaluating the combined effects of solar energy projects on desert species while including scenarios of future climate and land use. This research will be useful for environmental review during the permitting process.

To provide data to run these models, the researchers modeled species distributions for 65 desert species of concern in the DRECP Plan Area. These models were applied to map historical habitat suitability and projected into the future under different climate change scenarios. The species distribution models have contributed to the basic information used in the DRECP's reserve design and impact assessment.



Map of compatibility of solar energy development with biological resources.

Contractor: UC Santa Barbara

Amount: $383,787

Term: March 2011 to December 2013

Status: Final report in review

Mapping Habitat Distributions of Desert Rare Plants

California's deserts are home to a number of rare plants, spread widely in low numbers or concentrated in a few small patches. Because they are rare, little is known about where they might conflict with renewable energy development. It is critical, therefore, to maximize the limited data that have been previously collected to expedite planning and permitting.

This project compiled new, accurate coordinate data for 6,563 specimens of Mojave and Colorado Desert rare plants housed in the Jepson Herbarium at the University of California, Berkeley. This referenced plant specimen data, along with additional sources of location data, can be mapped, exported, and viewed online. New occurrence records for these plants are being input into the California Natural Diversity Database. This database, managed by the California Department of Fish and Wildlife, is the central biological data repository that provides fundamental biological information used to prepare environmental documents and identify rare animal and plant species that could be located on sites proposed for development, including renewable energy facilities. The data will help fill biodiversity data gaps in California deserts that hinder the environmental review of proposed energy facilities.

Researchers modeled the distribution of these plant species from this database to use in DRECP planning. Researchers developed a rigorous modeling method to improve predictions of potential habitat for eight rare plant species. The data used to develop the models and resulting maps of rare plant distribution are freely available to the public, including state and federal agencies, nongovernmental organizations, private industry, and academia.

Overall, this project provides both a method and an assessment of the accuracy and potential usefulness of habitat suitability models for rare plant conservation and mitigation planning to help minimize the impact of projects in the California desert.

Mojave milkweed, Asclepias nyctagynifolia

Photo: Bruce Pavlik

Contractor: UC Davis

Term: October 2010 to September 2014

Status: Final report in preparation

Amount: $580,907

Improving Decision Support Relative to Solar Energy Projects and the Desert Tortoise

Given the large scale of solar energy projects, the lack of information and tools to assess and mitigate the interactions of sensitive plants, animals, and habitats have led to permitting and construction delays. Research must address the information gaps and uncertainties that can cause delays in siting renewable energy projects. A major concern for permitting utility-scale solar projects has been assessing and reducing impacts to the desert tortoise, which is listed as threatened under both state and federal endangered species regulations.

In the past, land-disturbing projects in the California Mojave Desert could lower their impacts solely through land acquisition. Because proposed solar energy development projects command thousands of acres of land, acquiring enough acreage of good quality habitat to offset proposed projects with land acquisition alone has become problematic, and other types of management actions must be included in mitigation packages.

Previous research funded by the Energy Commission developed a spatial decision support system (SDSS). The Desert Tortoise Spatial Decision Support System is a Web-based modeling tool that quantifies the impacts of threats to desert tortoise populations by modeling the implementation of a permitted solar project, as well as identifying and prioritizing recovery actions that are most likely to reduce those threats. This project is continuing to improve and expand the decision-support models, including assessing the effects of population fragmentation resulting from multiple large-scale solar developments, testing impact models using actual solar project data, and making them run faster for real decision-making situations. It will provide users with measures of uncertainty for impact and mitigation calculations, increasing defensibility and transparency in decision-making. It will also be extended from assessing only individual energy projects to assessing cumulative impacts of multiple large-scale solar developments and climate change.

The Desert Tortoise

Photo: Flickr, Creative Commons (Joshua Tree National Park Service)

Contractor: Redlands Institute, University of Redlands

Term: June 2012 to March 2015

Status: Final report in preparation

Amount: $563,776

Cofunding: $ 62,970

Improving Mitigation Success for Desert Tortoises at Renewable Energy Development Projects

The desert tortoise (*Gopherus agassizii*), perhaps the most iconic species for the desert, is listed as threatened on both the California and federal Endangered Species lists. Large-scale solar developments are crucial to achieving California's renewable energy goals; however, they can have negative impacts on the tortoise population. These impacts must be mitigated by developers. Ensuring adequate survival of young tortoises is critical for wild desert tortoise populations to thrive. However, little understanding of the ecology, habitat use, and resource requirements of hatchling and juvenile desert tortoises is a serious data deficiency.

This project is rigorously evaluating the effectiveness of "head-starting" and "jump-starting" as innovative mitigation tools for improving the survival of juvenile tortoises. Head-starting involves maintaining eggs and juveniles in semi natural enclosures to protect them from predators. Jump-starting provides rain supplementation that mimics natural rainfall in wetter years, a method suggested to nearly double the growth rate of hatchlings. Survivorship and growth of head-started and jump-started tortoises at the Ivanpah Desert Tortoise Research Facility will be compared to free-ranging hatchlings released directly into Ivanpah Valley after hatching. Radio-telemetry data are being collected on released hatchlings to increase understanding of the habitat requirements, causes of mortality, and space use of desert tortoises across this stage of their life history. The effectiveness of captive rearing as a mitigation tool for desert tortoise recovery is being evaluated, especially as it relates to ensuring long-term persistence of populations in protected areas to offset losses from energy development projects elsewhere in California deserts. Preliminary results on growth rate and survival have been encouraging.

Measuring growth of desert tortoise hatchling.

Photo: Brian Todd

Contractor: UC Davis

Term: November 2010 to March 2015

Status: Final report in preparation

Amount: $238,310

Cofunding: $46,000

Effects of Solar Development and Operation on Desert Kit Foxes

The reticent kit fox is the smallest and rarest member of the dog family. Two kit fox subspecies are found in California, the San Joaquin kit fox and the desert kit fox. While many studies have been conducted on the endangered San Joaquin kit fox, information on the desert kit fox is limited to ecological and demographic data necessary to determine population trends and demographic patterns. The desert kit fox, which is found throughout California's Mojave and Colorado Deserts, was petitioned for inclusion on California's Endangered Species List in March 2013, with large-scale energy development and disease cited among a number of potential threats. When subject to stress, which can be caused by habitat destruction, kit foxes more easily succumb to disease. More information is required to accurately evaluate and assess the potential impacts of utility-scale solar projects to desert kit fox populations at local and regional scales.

This research will quantify desert kit fox movements and home ranges in the Chuckwalla Valley at existing and planned future solar developments. Populations close to energy developments are being tracked by mortality-sensitive radio collars to determine their seasonal movements, as well as seasonal and annual home ranges of individual kit foxes. Samples are also being collected for disease testing and genetic analysis to study the population's susceptibility to disease and causes of death.

The collection of long-term data near utility-scale solar developments will provide scientific insights on how these projects may affect desert kit fox populations. A past outbreak of canine distemper among desert kit foxes caused concern and delay in solar project construction, and scientific research is needed to investigate disease prevalence and spread. With knowledge of how utility-scale solar projects affect the ecology of the desert, California can move forward with proactive siting as well as mitigation efforts to better facilitate the permitting of renewable energy projects.

Desert Kit Fox

Photos: Randel Wildlife Consulting, Inc.

Contractor: Randel Wildlife Consulting, Inc.

Amount: $606,257

Term: July 2012 to March 2015

Status: In progress

Population Viability and Restoration Potential for Rare Plants Near Solar Installations

When assessing potential impacts of renewable energy development, it is not enough to know if rare species occur. It is also important to analyze the potential risk of extinction from the cumulative impacts of widespread energy development and other activities.

Population viability analysis – a modeling technique based upon ecological, life history, and demographic data – evaluates local population extinction risks under different intensities of impacts over time. These models require detailed data on life history factors, such as rates of growth, reproduction, and survivorship.

This project is conducting population viability modeling of eight rare plants of conservation concern likely to be affected by utility-scale solar energy development in the Mojave and Colorado Deserts. To assemble the data required, the research team is collecting field data over four consecutive years at 57 study sites, supporting nine observational and seven experimental studies. The team has also installed herbivore exclusion treatments and experimental mock solar panel shading treatments.

The major challenge to studies of rare plant population viability in the desert is the tremendous year-to-year variation in weather conditions, primarily rainfall. Each year is unique in the pattern of plant germination, survival, flowering, and reproduction, which vary dramatically across a wide range of desert plant life. The rare plants studied in this project have been much more variable in their response to weather fluctuations than anticipated. Taking advantage of contrasting weather conditions during the first two study years, the research was expanded from two field seasons to four. Understanding the response of population rates of different plants to weather variability is essential to developing effective mitigation and restoration, especially as this variability may increase with climate change.

Results from these types of models for a few species can be used to make recommendations for mitigation, management, and restoration of a broader suite of desert plant species potentially affected by solar energy development.

A Few of the Rare Desert Plants Included in a Population Viability Analysis Study

Crucifixion thorn
Castela emoryi

Photo: Kara Moore

White margin beardstongue
Penstemon albomarginatus

Photo: Kara Moore

Wallace's Woolly daisy
Eriophyllum wallacei

Photo: Karen Tanner

Barstow woolly sunflower
Eriophyllum mohavense

Photo: Karen Tanner

Contractor: BMP Ecosciences

Amount: $753,100

Term: November 2010 to March 2015

Status: Final report in preparation

Estimating Golden Eagle Abundance in the DRECP Area

California's deserts have not been studied as thoroughly as more accessible regions, leaving energy development planners with comparatively little baseline data on where desert species occur, their habitat needs, and how and where they use the landscape. Field observations are the foundation for mapping and modeling species habitat essential for energy planning that ultimately reduces uncertainties associated with project permitting. Several species of concern are under study by researchers in the field, including the golden eagle.

Several high-priority research needs for management of the golden eagle, legally protected by the Bald and Golden Eagle Protection Act of 1940, were identified in 2012 to achieve DRECP goals. Achieving these goals requires an understanding of golden eagle population size and dynamics on a large spatial scale in the desert to accurately assess the impacts of wind and other energy development on that population. Regulators need this information to effectively address impacts from energy development.

This project surveyed golden eagle populations from an airplane flying along sample lines to assess the size of the population within the DRECP area and provide a valuable baseline for detecting changes over time. The researchers carried out two surveys in 2013 – one post fledging survey in summer and one winter survey in December. Golden eagles were also classified by their activity, group size, age class, and location and altitude.

During the survey period, two golden eagle groups were sighted during the summer, and three were sighted during the winter. These sample observations were used to estimate golden eagle density. Researchers then extrapolated these results to estimate a population of about 80 golden eagles during the summer and 135 during the winter in the DRECP area. Golden eagle abundance can be estimated in the DRECP using standard methodology, but the researchers recommend that more effort or a different survey design will be necessary to obtain a level of precision that will allow detection of increases or decreases in the eagle population over time.

Golden Eagle

Photo: Flickr, Creative Commons ("GrrlScientist")

Contractor: Humboldt State University

Amount: $200,000

Term: June 2013 to March 2015

Status: Final report in preparation

Golden Eagles, Their Prey, and Effects of Renewable Energy

To facilitate wind energy permitting in the DRECP Plan area and to ensure compliance with the Bald and Golden Eagle Protection Act, it is critical to assess the status of the golden eagle population in this region. Achieving DRECP goals regarding golden eagles requires an understanding of the golden eagle population dynamics in the desert and the impacts of wind and other energy development on that population so that the plan can identify mitigation strategies that effectively offset estimated impacts from energy development.

This project helps address this knowledge gap by assessing golden eagle demographics and habitat requirements in those portions of California's Mojave and Colorado Desert regions addressed by the DRECP. Specifically, this project is conducting surveys to determine the relationship between prey availability and golden eagle nesting success, which will provide information to assess potential habitat losses from wind and other energy development.

Golden eagle nesting success has been correlated with prey abundance, but currently there is little information on how golden eagles may be affected by the loss of foraging habitat and associated prey from alternative energy development in the planning area. Information from this research will be used to inform renewable energy siting and permitting by identifying areas of high and low prey availability.

This project is also developing a statistically robust protocol for surveying and monitoring golden eagles populations in the DRECP. A standardized protocol is necessary to ensure future golden eagle monitoring is scientifically sound and conducted consistently. Developing this protocol will promote energy development by improving the accuracy of risk predictions of its effects on golden eagles, as well as informing developers of survey and monitoring requirements.

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Contractor: U.S. Geological Survey

Term: June 2013 to March 2015

Status: In progress

Amount: $ 314,000

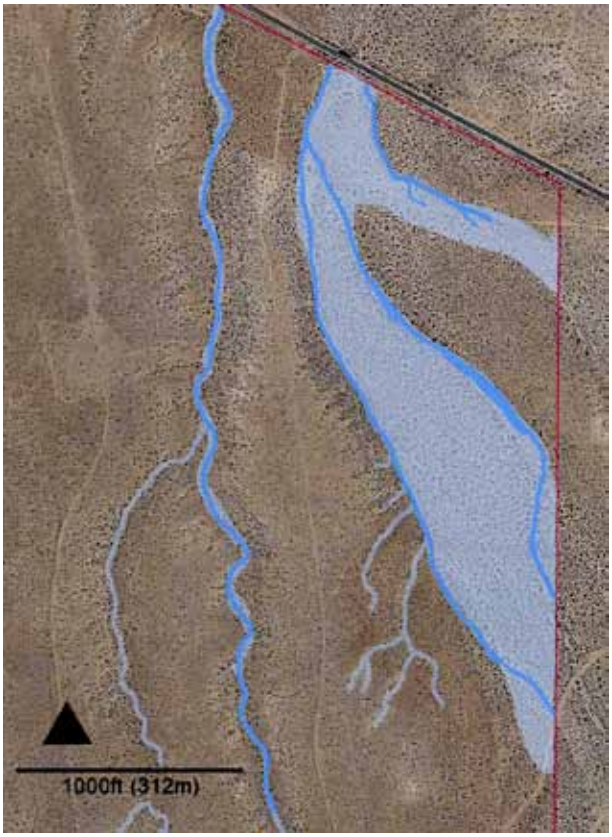
Cofunding: $14,700

Method for Characterizing Desert Streams to Facilitate Permitting Solar Energy Projects

Episodic streams, where water flows only occasionally, are common water features in the desert and perform the same critical hydrologic and habitat functions as year-round streams. It is crucial, therefore, that they be well managed and protected. Developing renewable energy facilities can detrimentally alter the landscape, drainage patterns, and natural habitat dependent on episodic streams.

To comply with the California Fish and Game Code, the California Department of Fish and Wildlife must be notified and consulted when there is a potential for project-related impacts to streams. The notification requires an accurate description of the natural streams at the site, which implicitly includes an assessment of the type of stream-related processes. However, such analysis and reporting have been problematic because no consistent protocol or guidance exists for project developers to use in place of methods and tools developed for other purposes. Consequently, projects may underreport the numbers of streams present. This has caused long and expensive delays in the permitting process.

To rectify this situation, this project produced a scientifically based, stream mapping method that project developers can use to inform the design and development of sustainable, low-impact projects in dryland environments. The Mapping Episodic Stream Activity protocols ease project permitting by providing a uniform delineation protocol and manual, help oversight agencies evaluate the potential impacts of a project, and provide a formal method with broad application for developing and evaluating land-use and resource management plans and practices.



Active streams using MESA method (tinted area) overlain onto conventional stream mapping. The increase in MESA area is due to inclusion of tributaries and floodplains.

Courtesy of Roland Brady. Map photo base courtesy of Google Earth.

Contractor: California State University, Fresno

Amount: $297,948

Term: June 2011 to September 2013

Status: Final report at http://www.energy.ca.gov/2014publications/CEC-500-2014-013/index.html

Carbon Balance in California Deserts: Impacts of Widespread Solar Power Generation

Recent studies have suggested that native desert vegetation may store substantial amounts of carbon, which could be released to the atmosphere during construction of renewable energy facilities. Large stores of carbon are buried as caliche, or calcium carbonate. Other studies suggest that clearing desert vegetation may also emit large amounts of carbon dioxide from disturbed caliche. If true, this release of carbon, and the potential inability of the soil to continue storing carbon, could reduce the net carbon emissions benefits associated with solar energy facilities.

In this project, the researchers developed techniques to measure baseline caliche carbon in areas proposed for development, developed models to assess organic and inorganic carbon sequestration, and determined if stripping native vegetation can create a loss of inorganic carbon. The study measured the stored inorganic carbon, as well as the organic carbon balances of different vegetation types. The isotopic ratios of carbon and oxygen were measured to assess dynamics of inorganic carbon. Using sensors, the flow rates of carbon in soil and the atmosphere of an undisturbed desert vegetation setting were measured and then compared with those from a site with the vegetation removed. Using the actual concentration and flux values, caliche formation and weathering were modeled. Researchers determined that carbon is cycled in complex ways, including between organic and inorganic forms in desert shrublands, and that inorganic carbon may be lost from areas stripped of desert vegetation.

The study concluded that protecting riparian woodlands and vegetation types with deep-rooted plants is important to protect buried inorganic soil carbon stocks and to protect carbon sequestration capacity provided by native vegetation. Planting short-statured shrubs or succulents in areas with solar panels to both reduce erosion and protect soil carbon was also recommended by the study team.

This exploratory study has shown that more research will be necessary to determine if renewable energy development that disturbs particular vegetation types would be less effective in meeting climate goals.

Aerial View of Undisturbed Land Alongside a Stripped and Graded Solar Facility During construction of solar developments, vegetation is often stripped and thousands of acres of soil are disturbed to build and maintain the solar power unit.

Photo: Imagery @2014 Digital Globe, U.S. Geological Survey, Map Data @2014 Google

Contractor: UC Riverside

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Term: June 2012 to January 2014

Status: Final report at http://www.energy.ca.gov/2014publications/CEC-500-2014-063/CEC-500-2014-063.pdf

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